Regency® COMMUNICATIONS INC.

SERVICE MANUAL

SELECTABLE TONE SQUELCH SYSTEM

MODEL MA-146

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SATELLITE BEACH FL

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SERVICE INFORMATION FOR MA-146

SERVICE INSTRUCTIONS
REGENCY MA-146
SELECTABLE TONE SQUELCH SYSTEM

A. GENERAL DESCRIPTION

The Regency selectable tone squelch system is available as a factory installed option or as a kit for Regency transceivers. This option equips the radio for operation on systems using Continuous Tone Controlled Squelch Systems (CTCSS).

This option is similar to other Regency CTCSS systems, but works on two non-simultaneous tones which are chosen with the front panel radio frequency switch.

B. CIRCUIT DESCRIPTION

Tone Receiving Condition:

Audio from the receiver discriminator is fed into the tone squelch board at terminal A2, and passes through the High Pass Filter IC601A, and back to the receiver's audio amplifier circuits at terminal A3. The high pass filter removes the CTCSS tones, which are below the normally utilized speech frequencies, so they will not be heard on the receiver loudspeaker.

Audio from the receiver discriminator (A2) is also fed into an active filter, consisting of IC601B, IC602A, and IC602B. This filter is a high Q, bandpass filter, that can be tuned for operation on any of the CTCSS tone frequencies. The components of the filter which determine the operating tone are precision resistors and capacitors: R601, R602, R603, R604, R605, R606, R607, R632, C601 and C602. Frequency adjustment resistors are R601 and R602 which are switched by FET's, Q605, Q606. The switching FET's are controlled by the logic circuits consisting of Q607 and Q604. A patch field is used to match tones with the front panel switch.

If the received tone is the proper one, as determined by the bandpass filter, it will be present in the output of IC602A and will be amplified by IC603A, and then rectified to a D.C. signal by the tone rectifiers CR601 and CR602. This D.C. signal is then amplified further by the D.C. amplifier, IC603B. The output of IC603B is normally high, and goes to a low voltage upon receipt of proper tone. This output appears at terminal K7, which connects to the corresponding terminal K7 on the receiver chassis, and is used to disable the receiver audio section when no tone is being detected.

Transmitting and Monitoring Condition:

Both the block diagram and the full schematic show a terminal point K5, which is connected to the hang up button on the back of the microphone. When the radio is installed, the microphone hanger is connected to the chassis (ground)

of the automobile, either by being mounted on a metal portion of the vehicle, or by a suitable wire to the vehicle ground. When the microphone is in its hanger, point K5 is grounded; this is the normal "receive" condition of the tone squelch system. Operation of the system in the "receive" condition has been described above.

When the microphone is removed from the hanger, point K5 becomes ungrounded causing the base of Q601 to go positive. This causes the collector of Q601 to drop to a tenth of a volt or so, causing Q602 to be turned "off", removing the effective short circuit that the collector had been creating across the junction of R622 and R624. With this short removed, a feedback path around the bandpass filter, through IC603A, R624, R622 and C607 is created. The frequency of oscillation is determined by the frequency determining elements. This oscillation output is amplified by IC603B to cause a low voltage at K7, just as it would if it were receiving an incoming tone signal, permitting the audio system to operate.

Summarizing the above, when the microphone is off-hook, K5 is ungrounded, the bandpass filter begins to function as an oscillator, and pin K7 goes low, allowing the receiver to operate. During the time that the microphone is off-hook, and prior to the time that the microphone has been depressed for transmitting, the receiver will hear any signals on the channel regardless of whether or not they have the proper CTCSS tone. This is the "monitoring" condition of the radio.

The oscillation output of the bandpass filter is fed to U2, and thus to the modulation section of the transmitter. When the transmitter is activated by pushing the microphone button, it is modulated by the CTCSS tone.

The amplitude of the tone voltage sent to the transmitter is controlled by R616, which is the control for adjusting the amount of modulation deviation caused by the tone. After the transmitter has been adjusted for proper modulation deviation on speech, according to the instructions given in the transmitter tuning procedure, R616 should be set to provide tone modulation deviation of plus and minus 500 Hz.

C. INSTALLATION

Mount the option board as indicated in Figure 8 with the two sheet metal screws supplied, by inserting the screws from the solder side of the P.C. board. (Both the top and bottom covers will need to be removed.)

Plug the jumper kit onto the option board pins by matching the pin symbols with the sleeves on the wired receptacles. See Parts Placement.

Remove JO204 from the radio (pins A2 & A3) and insert the receptacles to the proper pins, (as indicated in Figure 8) from the cable on the option board by matching pin symbols with the sleeves on the wired receptacles.

D. ADJUSTMENT PROCEDURE

Tone Setting Instructions (Changing or correcting tone operating frequency)

Matching the Tone to the Frequency:

The full potential of the MA-146 package is best realized in systems using more than one tone on a given radio frequency, such as accessing different repeaters. Points KØ, K1, K2 and K3 (from frequency selector switch) extend into a patch field so that one of the two tones available may be chosen for a given radio frequency.

Example: It is desired that a four channel unit operate on two radio frequencies and two tone frequencies. F1 is to be used in the first two switch positions with Tone 1 in the first and Tone 2 in the second switch position. F2 is to be used in the second two switch positions with Tone 1 in the third and Tone 2 in the fourth switch position. CR608 and CR610 are jumpered to the junction of CR606/R636 and CR604 and and CR611 are jumpered to the junction of CR607/R637.

Adjusting the Tone Frequency:

The tone frequency is determined by (a) the insertion of jumpers to determine which of three bands of operation is desired, and (b) the adjustment of a precision potentiometer to determine the specific tone frequency.

For purposes of installing the jumpers, the total CTCSS frequency is divided into three bands, the low band being 67.0 Hz to 110.0 Hz; the middle band 114.8 Hz to 192.4 Hz, and the high band 203.5 Hz to 250.3 Hz.

Figure 2A shows the jumper locations. Determine which band includes the desired frequencies, and insert (or remove) jumpers according to the following chart:

67.0 Hz to 110.9 Hz	Low Band	JU601,JU602,JU603,JU604 are all removed.
114.8 Hz to 192.4 Hz	Middle Band	JU601,JU603, in place. JU602,JU604 removed.
203.5 Hz to 250.3 Hz	High Band	JU602,JU604 in place. JU601,JU603 removed.

Note: Both frequencies must lie in the same band.

After soldering or unsoldering jumpers, at least five minutes should elapse before making any final frequency adjustment. This is necessary to permit the precision resistors and capacitors in the vicinity of the soldering points to stabilize in temperature.

Final frequency adjustment must be made with the tone board installed in the radio. Put the unit into the "monitor and transmit" condition by lifting the microphone off the hook. Turn the tone output potentiometer R616 fully counter-clockwise and connect the tone measuring equipment to point U2. Select a front panel frequency switch, then carefully adjust a precision potentiometer to obtain the wanted tone frequency. If no frequency change occurs, try the other pot. Turning the pot clockwise increases frequency. Reset the front panel switches such that the second tone frequency will appear at point U2 and adjust the other precision potentiometer.

Caution: Accurate frequency setting is necessary on CTCSS (tone squelch) systems. When making the above adjustments, be sure that you set the tone as precisely as possible. If the tone board is to operate on a system using reed type tone boards, be sure that your frequency setting is within .1 or .2 Hz if possible. Especially on reed tone systems, it is advisable to measure the tone frequency of several of the existing units; it is not safe to assume that the system is really operating on exactly the frequency stamped on the nameplates.

It is recommended that a tone generator and an X-Y scope be used to obtain a lissajois pattern on the scope. The generator should have a resolution of .1% of the desired CTCSS tone frequency (i.e., if tone frequency desired is 100 Hz, the tone generator should be accurate to 100.0 Hz). Set the generator to desired frequency and connect the generator to the horizontal input of the scope. Connecting the vertical input of the scope to U2 (on the tone board) a lissajois pattern is obtained.

Setting Tone Modulation Deviation:

Insert a 500 millivolt, 1000 Hz tone into pin 4 of the microphone jack. Adjust the transmitter deviation control to obtain ±5 KHz peak modulation deviation (or chosen system modulation deviation). Remove injected signal and adjust CTCSS tone deviation control (R616) to desired system tone deviation (typically 500 Hz).

Setting Tone Receive Threshold:

With transceiver in receive condition, and the microphone hang up button grounded to the transceiver chassis, inject a signal of the appropriate frequency into the transceiver antenna jack. Modulate this signal at the desired CTCSS tone frequency, with a deviation of one-half of the desired system tone deviation (e.g., if a system CTCSS tone deviation of 500 Hz is desired, generator deviation would be ±250 Hz). Adjust R610 (on the tone board) until the signal just opens the tone squelch system, and allows the receiver audio to function.

E. SPECIFICATIONS (With Microcom H40 Series Radios)

1. CTCSS Code Freq. Range	67-110.9 Hz (Band 1)	Two different
	114.8-192.4 Hz (Band 2)	tones tunable
	203.5-250.3 Hz (Band 3)	within the band
2. CTCSS Modulation Capability	.5 to 1 KHz Deviation, factory set at .5 KHz Dev	

3.	Pre Transmission Monitor	Microphone hangup activated
4.	Tone Squelch Opening	400 ms (max.)
5.	Receiver Hum and Noise	35 db (typ.)
6.	Encoder Response Time	10 ms (max.) (after hangup cycle) 500 ms (typ.) hangup cycle
7.	Tone Distortion on Transmit	2% (max.)
8.	TX Intermod Distortion	15% (max.)
9.	Frequency Stability	$\pm$.5% (max.) -30 to +60°C
10.	Sensitivity	6 db SINAD (max.) .20 µv Opening (typ.) @ $\pm$.5 KHz deviation
11.	Current Drain	60 ma (max.) @ 13.8v (P1)

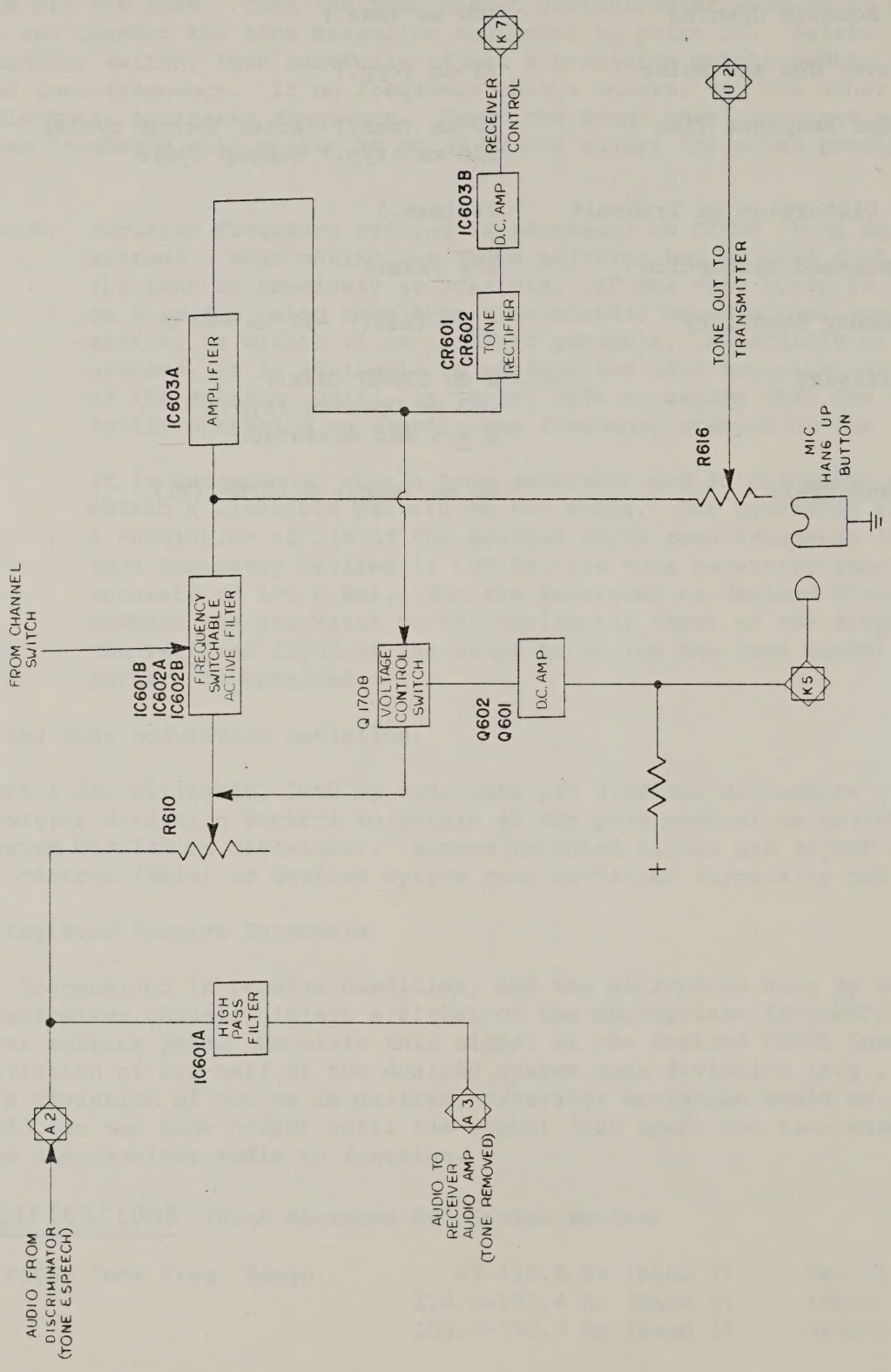
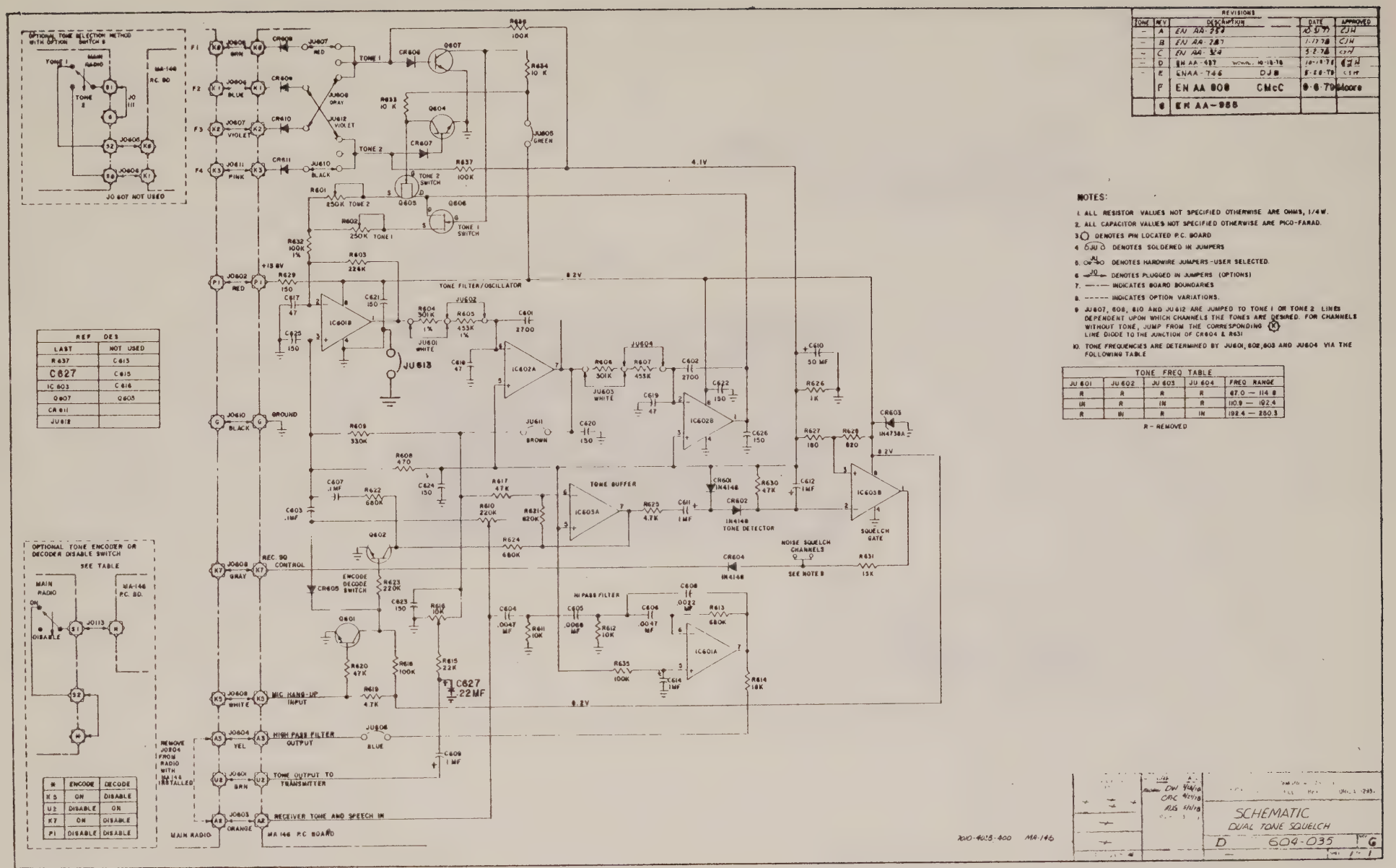


FIG 1 BLOCK DIAGRAM



REF DES	
LAST	NOT USED
R637	C613
C627	C615
IC 603	C616
Q607	Q605
CR611	
JU612	

K	ENCODE	DECODE
K5	ON	DISABLE
U2	DISABLE	ON
K7	ON	DISABLE
P1	DISABLE	DISABLE

REVISIONS				
TONE	REV	DESCRIPTION	DATE	APPROVED
-	A	EN AA-788	10-5-77	CJH
-	B	EN AA-787	1-17-78	CJH
-	C	EN AA-824	5-2-78	CJH
-	D	EN AA-837 Wrong 10-18-78	10-19-78	CJH
-	E	ENAA-746 DJB	5-28-79	CJH
	F	EN AA 808 CMcC	8-8-79	Moore
	G	EN AA-965		

NOTES:

1. ALL RESISTOR VALUES NOT SPECIFIED OTHERWISE ARE OHMS, 1/4W.
2. ALL CAPACITOR VALUES NOT SPECIFIED OTHERWISE ARE PICO-FARAD.
3. ○ DENOTES PIN LOCATED P.C. BOARD
4. JU 8 DENOTES SOLDERED IN JUMPERS
5. JU 8 DENOTES HARDWIRE JUMPERS-USER SELECTED.
6. JU DENOTES PLUGGED IN JUMPERS (OPTIONS)
7. —— INDICATES BOARD BOUNDARIES
8. ----- INDICATES OPTION VARIATIONS.
9. JU607, 608, 610 AND JU612 ARE JUMPED TO TONE 1 OR TONE 2 LINES DEPENDENT UPON WHICH CHANNELS THE TONES ARE DESIRED. FOR CHANNELS WITHOUT TONE, JUMP FROM THE CORRESPONDING (K) LINE DIODE TO THE JUNCTION OF CR604 & R631
10. TONE FREQUENCIES ARE DETERMINED BY JU601, 602, 603 AND JU604 VIA THE FOLLOWING TABLE

TONE FREQ TABLE				
JU 601	JU 602	JU 603	JU 604	FREQ RANGE
R	R	R	R	67.0 — 114.8
IN	R	IN	R	110.9 — 192.4
R	IN	R	IN	192.4 — 280.3

R - REMOVED

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	DH 9/4/78	SCHEMATIC	
	CRC 9/4/78	DUAL TONE SQUELCH	
	MJS 9/4/78	D 604-035	G

FIGURE 2

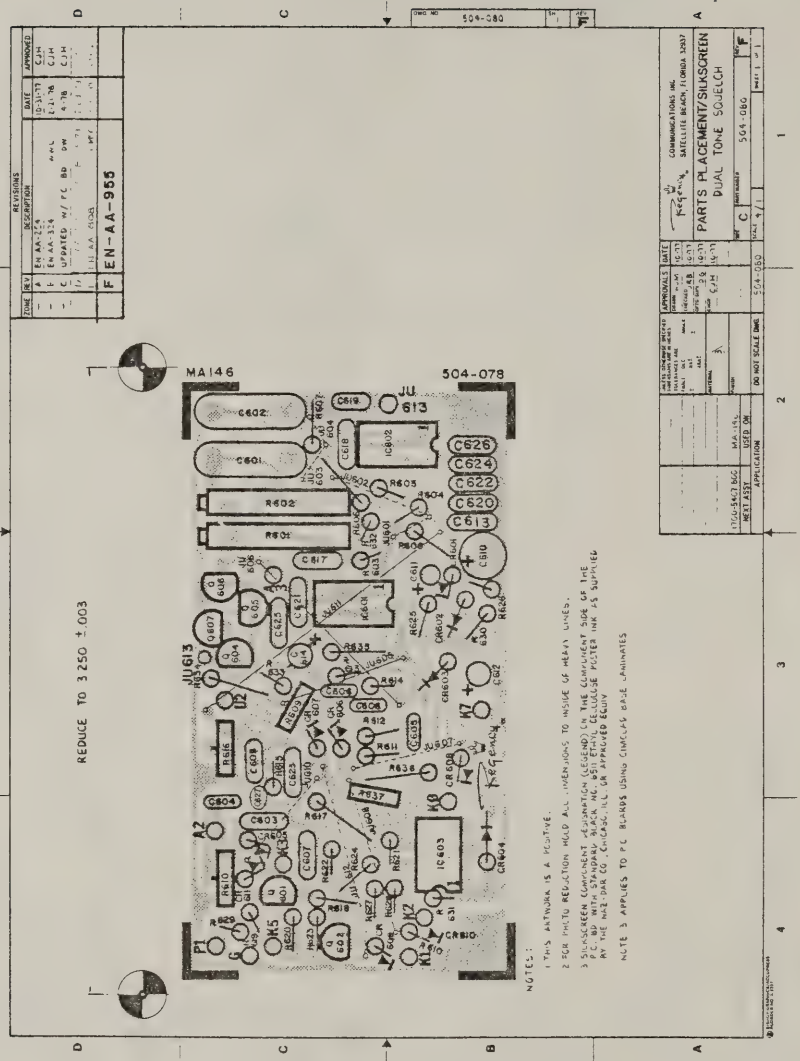

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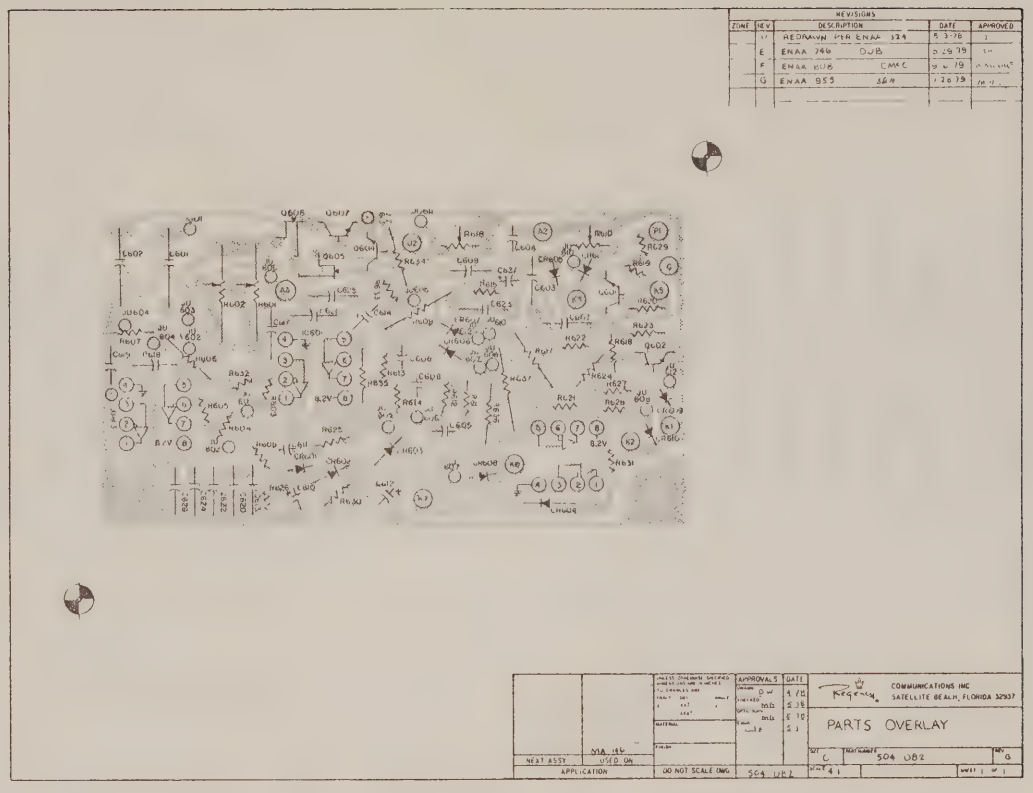
FIGURE 3



504-078 FIGURE 4

PARTS LIST

MA-146

CAPACITORS

LOCATION	DESCRIPTION	P/N
C601	2700pf 5% 5-0V(SM)	1504-0272-505
C602	2700pf 5% 500V(SM)	1504-0272-505
C603	.1mf 20% 12V(MC)	1502-0104-005
C604	.0047mf 10% 100V(MY)	1508-0472-610
C605	.0068mf 10% 100V(MY)	1508-0682-610
C606	.0047mf 10% 100V(MY)	1508-0472-610
C607	.1mf 20% 12(MC)	1502-0104-005
C608	.0022mf 10% 100V(MY)	1508-0222-610
C609	.1mf 20% 12V(MC)	1502-0104-005
C610	50mf 20% 15V(ELECT)	1513-0500-001
C611	1mf 16V(ELECT)	1513-0010-002
C612	1mf 16V(ELECT)	1513-0010-002
C613	Not Used	
C614	1mf 20% 15V(TANT)	1515-1010-003
C615	Not Used	
C616	Not Used	
C617	47pf 50V(RD)	1524-0470-002
C618	47pf 50V(RD)	1524-0470-002
C619	47pf 50V(RD)	1524-0470-002
C620	150pf 20% 50V(CD)	1523-0151-002
C621	150pf 20% 50V(CD)	1523-0151-002
C622	150pf 20% 50V(CD)	1523-0151-002
C623	150pf 20% 50V(CD)	1523-0151-002
C624	150pf 20% 50V(CD)	1523-0151-002
C625	150pf 20% 50V(CD)	1523-0151-002
C626	150pf 20% 50V(CD)	1523-0151-002

RESISTORS

R601	200K(VAR)	4751-0204-007
R602	200K(VAR)	4751-0204-007
R603	226K(MF)	4709-3402-406
R604	348K(MF)	4709-3402-403
R605	453K(MF)	4709-3402-404

RESISTORS (CONT)

LOCATION	DESCRIPTION	P/N
R606	348K(MF)	4709-3402-403
R607	453K(MF)	4709-3402-404
R608	470ohm	4701-0471-042
R609	330K	4701-0334-042
R610	220K(VAR)	4751-0224-002
R611	10K	4701-0103-042
R612	10K	4701-0103-042
R613	680K	4701-0684-042
R614	18K	4701-0183-042
R615	22K	4701-0223-042
R616	10K(VAR)	4751-0103-002
R617	47K	4701-0473-042
R618	100K	4701-0104-042
R619	4.7K	4701-0472-042
R620	47K	4701-0473-042
R621	820K	4701-0824-042
R622	680K	4701-0684-042
R623	220K	4701-0224-042
R624	680K	4701-0684-042
R625	4.7K	4701-0472-042
R626	1K	4701-0102-042
R627	180ohm	4701-0181-042
R628	820ohm	4701-0821-042
R629	150ohm	4701-0151-042
R630	47K	4701-0473-042
R631	15K	4701-0153-042
R632	100K(MF)	4709-3402-405
R633	10K	4701-0103-042
R634	10K	4701-0103-042
R635	100K	4701-0104-042
R636	100K	4701-0104-042
R637	100K	4701-0104-042

DIODES

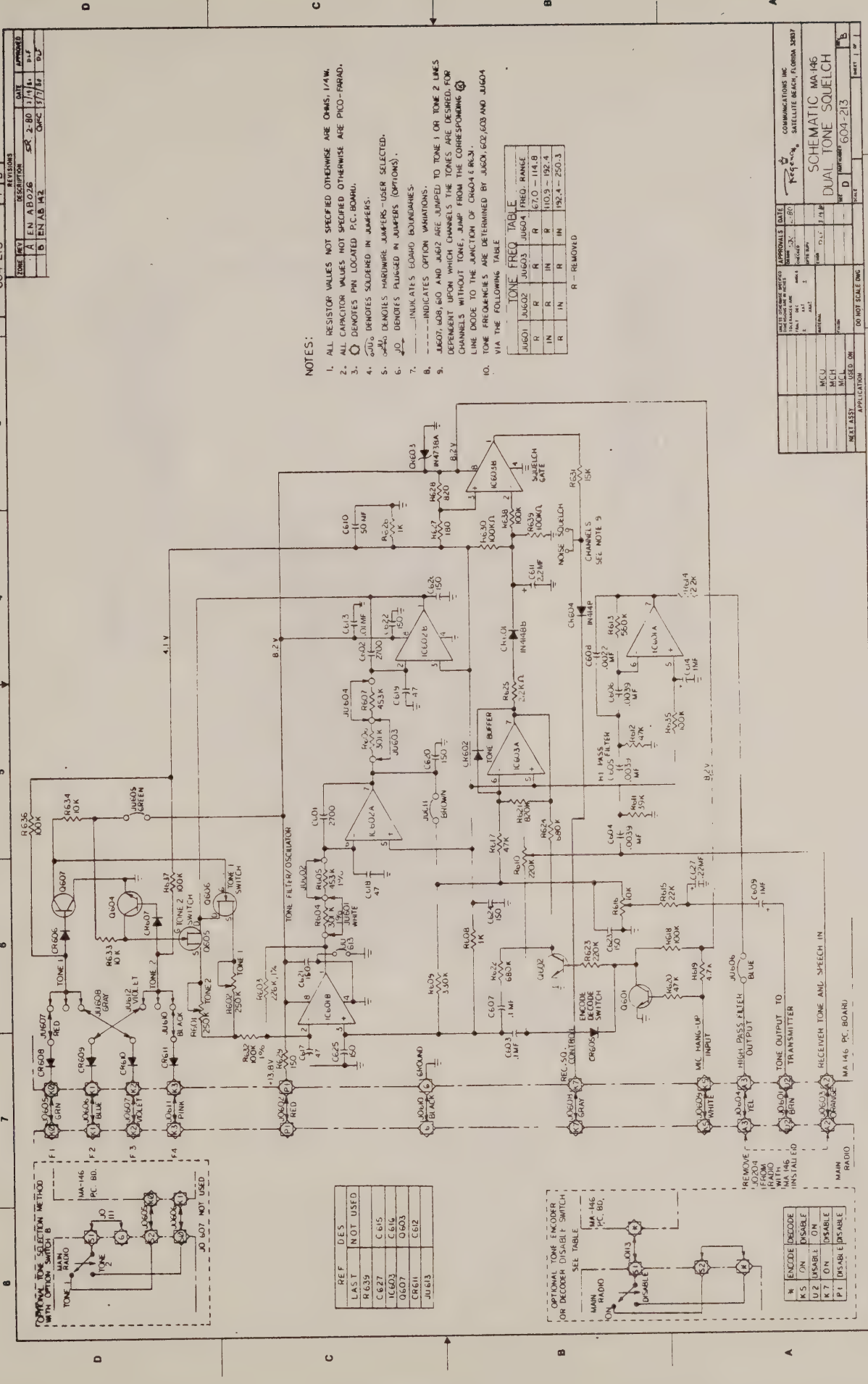
LOCATION	DESCRIPTION	P/N
CR601	SIL	4805-1241-200
CR602	SIL	4805-1241-200
CR603	ZENER 8.2V	4808-0000-009
CR604	SIL	4805-1241-200
CR605	SIL	4805-1241-200
CR606	SIL	4805-1241-200
CR607	SIL	4805-1241-200
CR608	SIL	4805-1241-200
CR609	SIL	4805-1241-200
CR610	SIL	4805-1241-200
CR611	SIL	4805-1241-200

TRANSISTORS

Q601	SIL NPN	4801-0000-010
Q602	SIL NPN	4801-0000-010
Q603	Not Used	
Q604	SIL NPN	4801-0000-010
Q605	JUNCT FET	4811-0000-030
Q606	JUNCT FET	4811-0000-030
Q607	SIL NPN	4801-0000-010

INTEGRATED CIRCUITS

IC601	DUAL OP AMP	3130-3167-909
IC602	DUAL OP AMP	3130-3167-909
IC603	DUAL OP AMP	3130-3167-909



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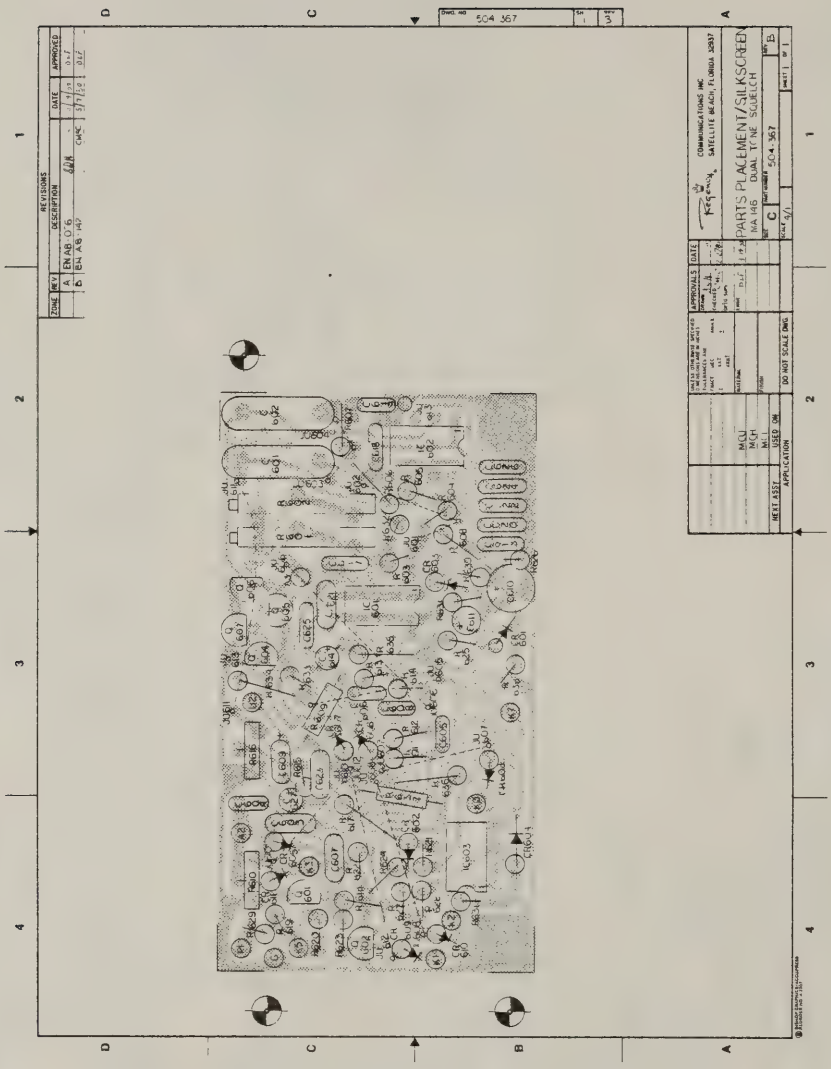

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FIGURE 6

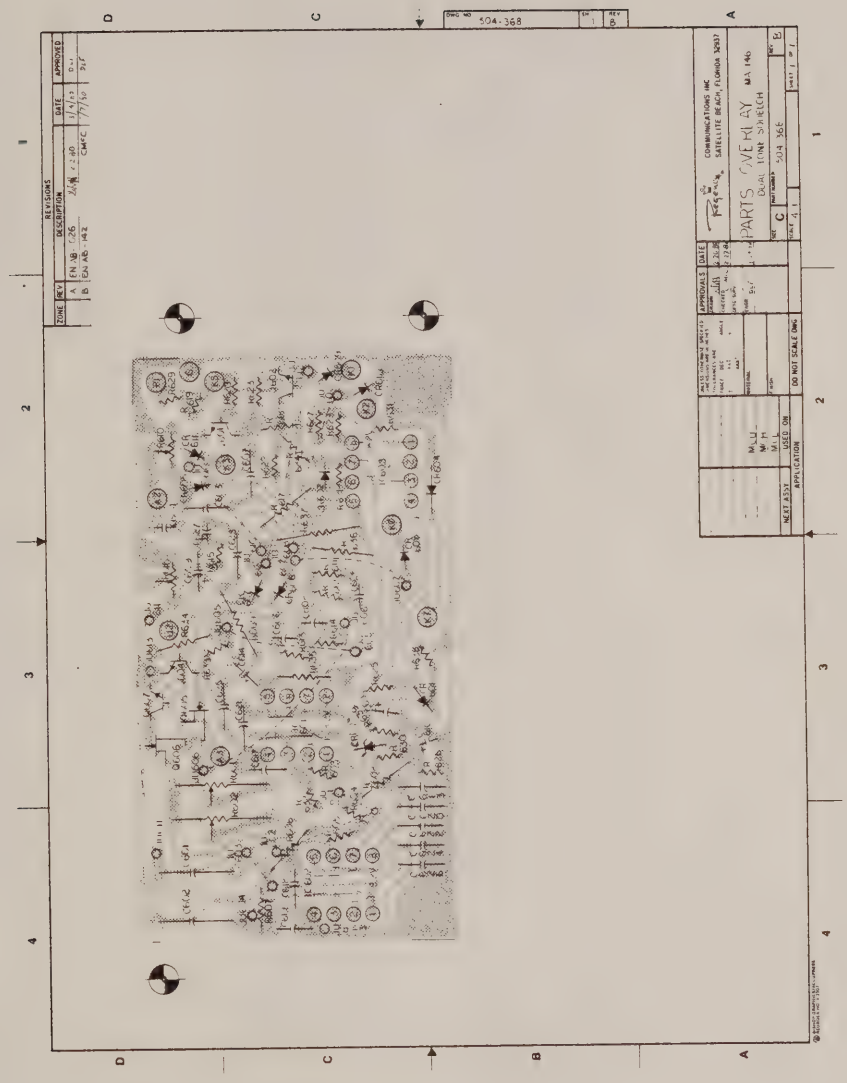

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FIGURE 7

PARTS LIST

MA-146

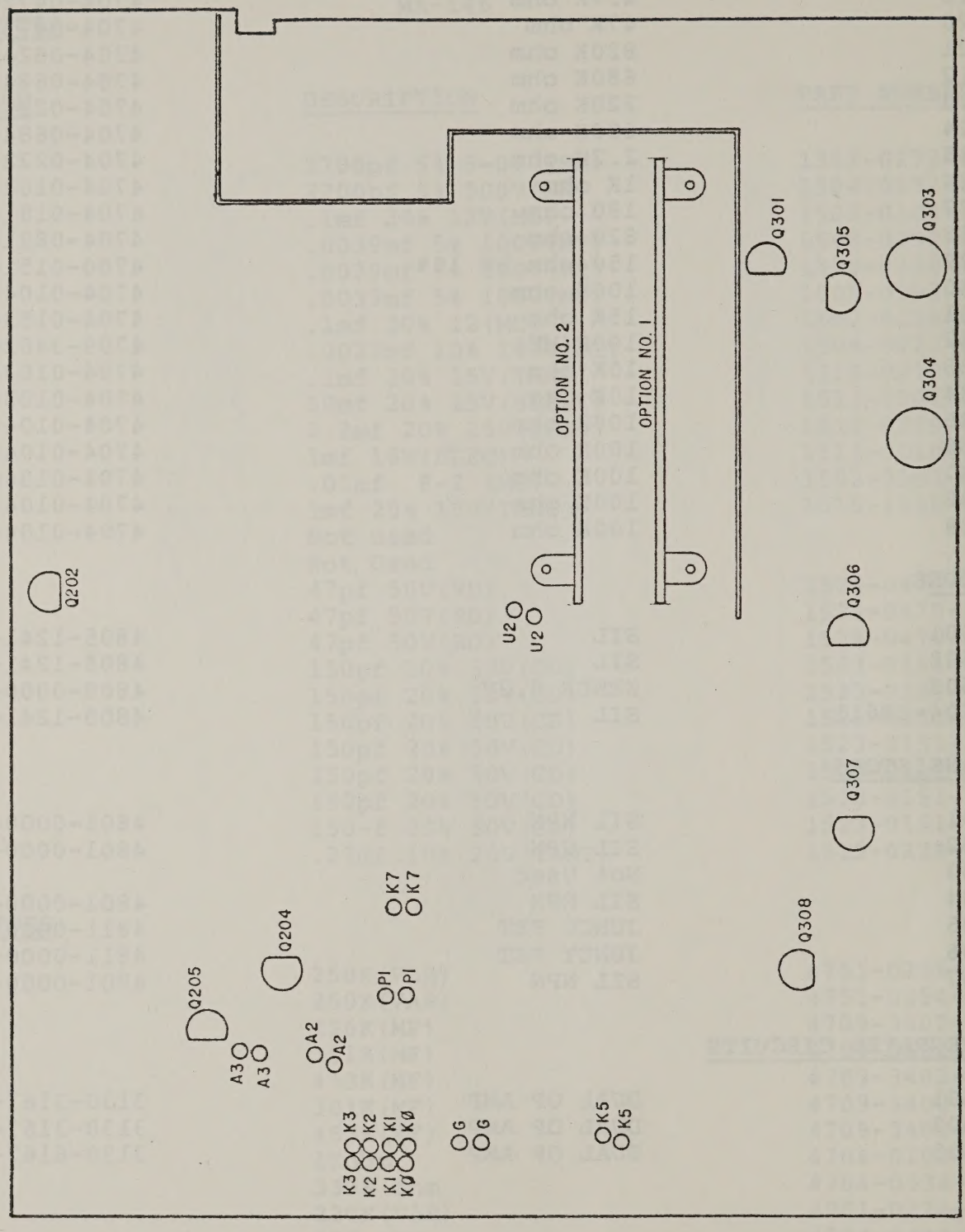
CAPACITORS

LOCATION	DESCRIPTION	PART NUMBER
C601	2700pf 5% 5-0V (SM)	1504-0272-505
C602	2700pf 5% 500V(SM)	1504-0272-505
C603	.1mf 20% 12V(MC)	1502-0104-005
C604	.0039mf 5% 100V(MY)	1508-0392-510
C605	.0039mf 5% 100V(MY)	1508-0392-510
C606	.0039mf 5% 100V(MY)	1508-0392-510
C607	.1mf 20% 12(MC)	1502-0104-005
C608	.0022mf 10% 100V(MY)	1508-0222-610
C609	.1mf 20% 15V(TANT)	1515-0010-003
C610	50mf 20% 15V(ELECT)	1513-0500-001
C611	2.2mf 20% 25V(TANT)	1515-0229-005
C612	1mf 16V(ELEC)	1513-0010-002
C613	.01mf 8-2 (MC)	1502-0103-006
C614	1mf 20% 15V(TANT)	1515-1010-003
C615	Not used	
C616	Not Used	
C617	47pf 50V(RD)	1524-0470-002
C618	47pf 50V(RD)	1524-0470-002
C619	47pf 50V(RD)	1524-0470-002
C620	150pf 20% 50V(CD)	1523-0151-002
C621	150pf 20% 50V(CD)	1523-0151-002
C622	150pf 20% 50V(CD)	1523-0151-002
C623	150pf 20% 50V(CD)	1523-0151-002
C624	150pf 20% 50V(CD)	1523-0151-002
C625	150pf 20% 50V(CD)	1523-0151-002
C626	150-f 20% 50V(CD)	1523-0151-002
C627	.22mf 10% 20V(TANT)	1515-0228-009

RESISTORS

R601	250K(VAR)	4751-0254-007
R602	250K(VAR)	4751-0254-007
R603	226K(MF)	4709-3402-406
R604	301K(MF)	4709-3402-402
R605	453K(MF)	4709-3402-404
R606	301K(MF)	4709-3402-402
R607	453K(MF)	4709-3402-404
R608	1Kohm	4704-0102-032
R609	330K ohm	4704-0334-032
R610	220K(VAR)	4751-0224-002
R611	39K ohm	4704-0393-032
R612	47K ohm	4704-0473-032
R613	560K ohm	4704-0564-032
R614	2.2K ohm	4704-0222-032
R615	22K ohm	4704-0223-032
R616	10K(VAR)	4751-0103-002
R617	47K ohm	4704-0473-032
R618	100K ohm	4704-0104-032

LOCATION	DESCRIPTION	PART NUMBER
R619	4.7K ohm	4704-0472-032
R620	47K ohm	4704-0473-032
R621	820K ohm	4704-0824-032
R622	680K ohm	4704-0684-032
R623	220K ohm	4704-0224-032
R624	680K ohm	4704-0684-032
R625	2.2K ohm	4704-0222-032
R626	1K ohm	4704-0102-032
R627	180 ohm	4704-0181-032
R628	820 ohm	4704-0821-032
R629	150 ohm ¼W 10%	4700-0151-042
R630	100K ohm	4704-0104-032
R631	15K ohm	4704-0153-032
R632	100K(MF)	4709-3402-405
R633	10K ohm	4704-0103-032
R634	10K ohm	4704-0103-032
R635	100K ohm	4704-0104-032
R636	100K ohm	4704-0104-032
R637	100K ohm	4704-0104-032
R638	100K ohm	4704-0104-032
R639	100K ohm	4704-0104-032
DIODES		
CR601	SIL	4805-1241-200
CR602	SIL	4805-1241-200
CR603	ZENER 8.2V	4808-0000-009
CR604-CR611	SIL	4805-1241-200
TRANSISTORS		
Q601	SIL NPN	4801-0000-010
Q602	SIL NPN	4801-0000-010
Q603	Not Used	
Q604	SIL NPN	4801-0000-010
Q605	JUNCT FET	4811-0000-030
Q606	JUNCT FET	4811-0000-030
Q607	SIL NPN	4801-0000-010
INTEGRATED CIRCUITS		
IC601	DUAL OP AMP	3130-3167-909
IC602	DUAL OP AMP	3130-3167-909
IC603	DUAL OP AMP	3130-6167-909



OPTION MOUNTING LOCATION

FIGURE 8